CLAIMS

1. Device for drawing and depositing droplets (100, 200) of at least one liquid (32), comprising:

- an outer tube (101) with an opening (107) at one of its ends;
- a flange (109) defining said opening (107);
- a rod (111, 211, 221) capable of sliding inside said outer tube (101);
- an inner volume (117) between said rod (111, 211, 221) and the outer tube (101);
- a capillary-sized port (119) open in the wall of said outer tube (101), so that a pressure equal to that outside said port (119) is established in the inner volume (117);
- an element for closing (113, 213) said opening (107) connected to said rod (111, 211, 221), and in which, when said rod (111, 211, 221) is in a forward end position, said closure element (113, 213) comes into contact with the flange (109) and thus hermetically closes said opening (107) while, when the rod is not in this end position, a capillary-sized passage (115) enables the inner volume (117) to communicate with the outside.

2. Device according to claim 1, wherein the maximum cross-section of said passage (115) is on the order of 10^{-8} m^2 with an uncertainty on the order of 1 %, so that the volume of the deposited droplets is on the order of a nanoliter with an uncertainty on the order of 10 picoliters.

3. Device according to claim 1, wherein said closure element (113) is held in said fully forward position by means for applying an elastic force (123, 223).

4. Device according claim 1, wherein the cross-section of said passage (115) varies continuously on the basis of a relative position (Z) of said rod (111, 211, 221) with respect to said outer tube (101), between 0

and a maximum value, reached when said rod (111, 211, 221) is in said fully retracted position.

5. Device according to claim 1, wherein said closure element is a point (113).

6. Device according to claim 5, in which said point (113) is conical.

7. Device according to claim 1, wherein said closure element is a ball (213).

8. Device according to claim 3, wherein the means for applying an elastic force (123) is selected from a spring, an elastic beam, an elastic membrane, and a block of elastomer material.

9. Device according to claim 3, wherein the means for applying an elastic force (123) connect the end of the rod (111, 221) opposite the opening (107) to the outer tube (101).

10. Device according to claim 3, wherein the means for applying an elastic force (123) connect the end of the rod (211) opposite the opening (107) to a second rod (212), collinear to the first.

11. Device according to claim 9 or 10, wherein the closure element is secured to said rod (111, 211).

12. Device according to claims 1 to 8, wherein the means for applying an elastic force (123) connect the closure element to the end of the rod (221) on the side of the opening (107).

13. Device according to claim 4, wherein a position sensor (127) that enables the position (Z) of said rod (111, 211, 212, 221) inside said outer tube (101) to be measured.

14. Device according to claim 4, wherein an actuator (127) that enables the position (Z) of said rod (111, 211, 212, 221) inside said outer tube (101) to be adjusted.

15. Device according to claims 13 and 14, wherein the sensor (127) and the actuator (127) are constituted by a solenoid (127) and at least one portion of said rod (113) made of a material having a relative magnetic permeability μ_r substantially greater than 1.

16. Device according to claim 1, consisting at least partially of a material selected from a metal including stainless steel, glass, a plastic material and a polymer.

17. Device according to claim 1, wherein protective coatings on at least one portion of the surfaces are capable of coming into contact with at least one liquid (32) to be drawn or deposited, respectively.

18. Device according to claim 1, wherein hydrophobic coatings on at least one portion of the surfaces are capable of coming into contact with at least one liquid (32) to be drawn or deposited.

19. Device according to claim 1, wherein hydrophilic coatings on at least one portion of the surfaces are capable of coming into contact with at least one liquid (32) to be drawn or deposited.

20. Device according to claim 19, wherein in that at least one of said coatings consists of a hydrophilic material such as tungsten.

21. Device according to claim 1, wherein the capillary-sized port (119) is too small to enable a liquid (32) capable of being drawn or deposited from passing through it.

22. Device according to claim 1, wherein the capillary-sized port (119) enables the inner volume (117) to communicate with the atmosphere.

23. Device according to claim, wherein the capillary-sized port (119) is connected to a container (219) containing an inert gas.

24. Device according to claim 23, wherein the pressure of the inert gas in the container (219) can be adjusted so that it is possible to draw or deposit a liquid (32) with the assistance of the pneumatic effect.

25. Device according to claim 1, wherein the capillary-sized port (119) can be stopped so as to insulate the inner volume (117) from the environment. ,

26. Device according to claim 1, wherein said device is attached to a translation system (129) enabling it to be moved in the three dimensions with micrometric precision.

27. Device according to claim 26, wherein the translation system (129) is controlled by a computer (131).

28. Device according to claim 1, wherein said device is constituted by a cartridge pre-filled with a liquid (32).

29. Drawing and deposit head consisting of a plurality of drawing and deposit devices (100, 200) according claim 1, for depositing an array of droplets of at least one liquid (32).

30. Drawing and deposit head according to the previous claim, wherein the amount of said liquid (32) drawn or deposited by each device (100, 200) belonging to said drawing and deposit head can be controlled individually.

31. Method for drawing at least one liquid (32) using a device (100, 200) according to claim 1, comprising at least the following steps:

(a) immersing said device (100) in a container (31) containing the liquid (32);

(b) retracting said closure element (113, 212) so as to open the passage (115), and filling said inner volume (117) by means of hydrostatic pressure and capillarity; and

(c) extracting said device (100) and moving said closure element (113, 213) forward so as to close the passage (115).

32. Method for drawing at least one liquid (32) according to claim 31, wherein the retraction of said closure element (113, 213) is caused by the pressure exerted by said closure element (113, 213) on the base (33) of said container (31).

33. Method for drawing at least one liquid (32) according to claim 31, wherein the retraction of said closure element (113, 213) is caused by the actuator (127).

34. Method for drawing at least one liquid (32) according to claim 31, additionally comprising at least the following steps:

(d) moving said opening (107) at the end of said device (100) toward the surface of said liquid (32) to be drawn;

(e) retracting said closure element (113, 213) by the actuator (127) so as to open the passage (115), and filling said inner volume (117) by means of capillarity forces alone.

35. Method for drawing at least one liquid (32) according to claim 34, in which the liquid (32) is contained in a microwell.

36. Method for drawing at least one liquid (32) according to one of claims 34 or 35, wherein the amount of said liquid (32) that is drawn is controlled by a position adjusting (Z) of said rod (111, 211) inside said outer tube (101), and, consequently, the cross-section of said passage (115).

37. Method for deposition by contacting a liquid (32) according to claim 34, additionally comprising at least the following steps:

(f) positioning said device (100, 200) at the vertical of the point of the deposition surface (51) where the deposit is to be provided;

(g) placing said closure element (113, 213) in contact with said deposition surface (51), and opening said passage (115) by means of the pressure exerted by said closure element (113, 213) on said contact surface (51);

(h) depositing a controlled amount (53) of said liquid (32) by means of the combined forces of adhesion of said liquid (32) to the deposition surface, capillarity and weight; and

(i) lifting said device (100, 200) and moving said closure element (113, 213) forward so as to close the passage (115).

38. Contactless method for depositing at least one liquid (32) according to claim 37, additionally comprising at least the following steps:

(j) positioning said device (100) at the vertical of the point of the deposition surface (51) where the deposit is to be provided;

(k) retraction of said closure element (113, 213) by means of said actuator (127), which causes said passage (115) to open; and

(l) moving said closure element (113, 213) forward so as to close the passage (115), and depositing a droplet (61) of said liquid (32) by

means of the combined effect of the weight and the plunger effect caused by the forward movement of said closure element (113, 213).

39. Method for depositing at least one liquid (32) according to one of claim 37 or 38, wherein the amount of said liquid (32) that is deposited is controlled by adjusting the position (Z) of said rod (111, 211, 212, 221) inside said outer tube (101), and, consequently, the cross-section of said passage (115).

40. Method for washing a device (100, 200) according to claim 1, consisting of injecting, into said device, a pressurised detergent liquid (71) through the port (119), with said detergent liquid (71) being removed by suction via the passage (115), held open by retracting said closure element (113, 213).

41. Control system for adjusting the amount of liquid drawn or deposited by a method according to one of claims 31 to 39, wherein the translation system (129) presses said closure element (113, 213) against the base (33) or said deposition surface (33) with a constant force F, which can optionally be zero, and in that the relative position (Z_e) of said rod (111, 211, 212, 221) with respect to said outer tube (101) is determined by the sensor (127), said relative position (Z_e) is compared to its target value (Z_c), calculated on the basis of the amount of liquid (32) to be drawn or deposited, and the actuator (127) brings said relative position (Z_e) close to said target value (Z_c).

42. Control system for adjusting the amount of liquid drawn or deposited by a method according to one of claims 31, 32, 36 and 37, wherein the translation system (129) presses said closure element (113, 213) against the base (33) or said deposition surface (33) with a variable force F, and in that the relative position (Z_e) of said rod (111, 211, 212, 221) with respect to said outer tube (101) is determined by the sensor (127), said relative position (Z_e) is compared to its target value (Z_c), calculated on the basis of the amount of liquid (32) to be drawn or deposited, and the

translation system (129) brings said relative position (Z_e) close to said target value (Z_c).